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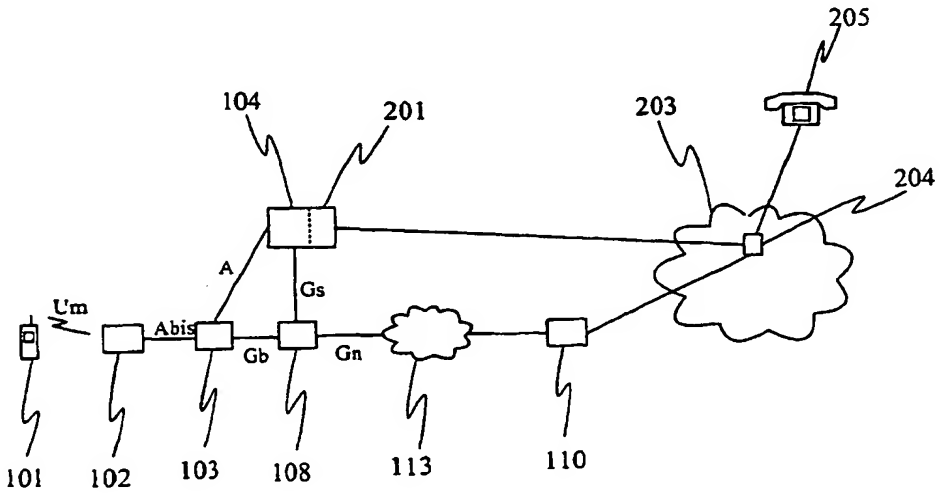

(57) Abstract

The invention relates to a method for guaranteeing the quality of a connection in a data-transmitting telecommunication system. In particular the invention relates to transmission of data through an Internet network, where at least one of the parties to the connection is a mobile station (101). According to the invention, a circuit-switched connection is set up in parallel with a packet-switched data transmission connection, and through that circuit-switched connection it is at least partly transmitted the data that requires a good transmission channel quality. Once such data type is speech data. In accordance with the invention, the circuit-switched connection is given an IP address of its own, which is used in connection establishment and data transmission. The circuit-switched connection may be realized through various arrangements in parallel with the packet-switched connection.

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Method for improving the quality of a telecommunication connection and a network element

The invention relates to a method for transmitting data in data networks, in which method it is ensured that data, especially speech data, is transmitted through a good enough telecommunication connection from the sender to the recipient.

In mobile communication systems the trend is toward packet-based transmission. The idea in packet-based transmission is to transmit the data in packets, so that the connection is used only when data is being transmitted. According to the present transmission arrangement data is transmitted using a circuit-switched arrangement in which the transmission channel is open all the time regardless of whether data is being transmitted or not.

The option of packet-based transmission is about to be included in present digital mobile communication systems, such as the GSM. This is accomplished e.g. by means of the so-called General Packet Radio Service (GPRS) network, the connection of which to, say, the GSM network calls for some new network elements and some changes in the old network elements.

Fig. 1 illustrates a possible arrangement of a GPRS network. Shown in the figure is a mobile station 101 which is connected via a base station 102 and base station controller 103 to a mobile switching center 104. A plurality of different networks, such as a public switched telephone network (PSTN) 105 and an SS7 network 106, for example, may be connected to the mobile switching center 104. The base station controller 103 includes a new network element (PCU, or, Packet Control Unit) 107 which controls the data packets. The packet network proper 114 is connected through the packet control unit 107 to the rest of the network topology. Between the GPRS backbone network 113 and the packet control unit 107 there is a serving GPRS support node (SGSN) 108. The GPRS network also includes a GPRS register 109 which stores information about GPRS equipment, for example. The GPRS network further includes gateway GPRS support nodes (GGSN) 110 through which other packet-based networks 111, such as Internet, OSI data, or X.25 networks, may be connected to the GPRS network. A continuous line between elements in Fig. 1 indicates that there is both data transmission and signaling between the elements. A broken line represents signaling between elements.

The introduction of the packet system brings about changes in terminal equipment. According to a proposal, terminal devices are categorized into three classes A, B

and C. Of these, class A terminals are the most advanced and are highly suitable for both packet-based and circuit-switched data transmission. In class A devices both a packet-switched and a circuit-switched connection may be active simultaneously. Class B devices are a little simpler and in them both the packet-switched and circuit-switched connection may exist simultaneously but only one of them may be active at a time. In class C devices, only one of said two connections may be established at a time. A special case of the C class is a terminal device designed purely for packet-based transmission.

Other networks see the GPRS network as an Internet subnetwork. The GPRS network has addresses of its own, which comply with the Internet Protocol (IP). In addition to the GPRS network addresses, mobile stations as well as other network elements in the network have IP addresses that facilitate data transmission between the sender and recipient.

In various packet-based data transmission applications, such as e.g. Internet applications, data may have many different forms. Data may consist of text, speech, images or the like. As data is transmitted in packet format through the GPRS network a problem may arise from the fact that the quality of the data transmitted deteriorates during the transmission for various reasons. The quality of the data is important e.g. in applications in which the data packets transmitted consist of speech data. One such application may be e.g. an Internet call. In such data types the quality of the data transmitted is affected by the delay of data packets, for example.

An object of this invention is to provide a method for keeping the quality of a connection good, especially in applications in which the data transmitted, such as speech data, requires a good transmission channel quality.

The objects of the invention are achieved by an arrangement in which data is transmitted using both packet-based transmission and circuit-switched transmission. Packet-based transmission is used when the data transmitted is such that a possible deterioration of data quality, caused by delays, for instance, will not degrade the intelligibility of the information contained in the data at the receiving end. Circuit-switched transmission is used when the data transmitted is of a type the intelligibility of which is affected by a possible deterioration of data quality.

The method according to the invention is characterized in that at least part of the data transmitted through a packet-switched connection is arranged so as to be transmitted at least partly through a circuit-switched connection.

The network element according to the invention is characterized in that it is adapted so as to transmit at least part of the data transmitted through a packet-switched connection at least partly through a circuit-switched connection.

Other advantageous embodiments of the invention are specified in the dependent claims.

In accordance with the invention an arrangement is realized by means of which speech data or the like is not transmitted in packets, but a circuit-switched connection is used to transmit the speech data or the like. The speech data or the like is separated from the rest of the data stream and directed at least partly through a circuit-switched connection to the recipient. The connections are optimized in such a manner that the capacity is used as efficiently as possible from the network standpoint. According to an advantageous embodiment of the invention the speech data or the like is transmitted between an Internet network and mobile station at least partly through a circuit-switched connection. According to a second advantageous embodiment the speech data or the like is transmitted between the packet-switched GPRS backbone network and mobile station at least partly through a circuit-switched connection. According to a third advantageous embodiment the speech data or the like is transmitted between a serving GPRS support node and mobile station at least partly through a circuit-switched connection.

The invention is described in detail in the following, referring to the accompanying Figures in which

Fig. 1 shows a possible topology of the GPRS network,

Fig. 2 shows a possible arrangement according to the invention,

Fig. 3 shows a second possible arrangement according to the invention, and

Fig. 4 shows a third possible arrangement according to the invention.

Like elements in the Figures are denoted by like reference designators. Fig. 1 was discussed above in conjunction with the prior art.

Fig. 2 shows a first embodiment according to the invention for setting up a connection from a mobile station 101 to an Internet network 203 through a packet-switched network. The Internet network 203 is shown to comprise one Internet server 204 with an Internet telephone connection 205. In addition to these network elements Fig. 2 shows a base station 102, base station controller 103, serving GPRS support

node 108, GPRS backbone network 113, gateway GPRS support node 110, mobile switching center 104 and a gateway (GW) 201. Between the elements there are suitable interfaces to serve the communication between the elements. Exemplary interfaces are shown in Figs. 2, 3 and 4.

Let us next consider a situation according to Fig. 2 in which the user of a mobile station 101 has initiated on his class A terminal device a connection to an Internet network 203, in which connection data is transmitted in packets. In this exemplary situation the Internet user wants to set up an Internet call to a person who has on his web site, for example, a so-called click-and-talk button by means of which an Internet call can be established. Thus at least speech data is transmitted during the Internet connection, but some other type of data may be transmitted, too. Normally an Internet call is established through the packet-switched GPRS network. In the arrangement according to the invention the mobile station 101 is arranged, upon establishing an Internet call, to set up a connection via a base station controller 103 to a mobile switching center 104 and further to a gateway 201. The advantage is that the connection from the mobile station 101 to the gateway 201 can be realized at least partly as a circuit-switched connection whereby the quality of the speech data transmitted can be kept better in the transmission. It is obvious to a person skilled in the art that the data sent to and received from the Internet network is in packet format, wherefore said gateway 201, along with other possible functions, is arranged so as to convert the speech data transmitted through the circuit-switched connection to packet format and vice versa.

When the user initiates a connection to an Internet server 204, IP addresses are used in the establishment of the connection. In this explanatory embodiment the mobile station 101 has an IP address of its own, to which address packet-based data sent from or via the Internet can be transmitted through the GPRS network. If the user of the mobile station 101 initiates a speech connection through a data transmission connection using the Internet Protocol, a second IP address may be advantageously arranged for the mobile station 101, to which second IP address the speech data is transmitted through a circuit-switched connection. Advantageously the address is such that data sent to the address is transmitted from the Internet network to the gateway 201. As the packet-form speech data arrives at the gateway 201, the gateway 201 converts the packet data into data to be transmitted through the circuit-switched connection and transmits said data to the mobile station 101 in accordance with the second IP address sent by the mobile station 101. If there were no separate address for speech data, the speech data would be transmitted to the mobile station

101 together with other possible data through the packet-switched GPRS network. It is obvious to a person skilled in the art that the speech data sent from the mobile station 101 is also transmitted via the gateway 201 at least partly through a circuit-switched connection to the recipient connected to the Internet network.

The mobile station 101 must send to the Internet server 204 the address to which the speech coming from the Internet is directed in packet format so that the speech data can be transmitted through the circuit-switched connection to the mobile station 101. Said IP address may be conveyed in many ways. According to a first example the mobile station 101, when establishing a circuit-switched connection via a mobile switching center 104 and gateway 201, may send the information of the IP address used in the speech connection to the Internet server 204 in a short message. The Internet server 204 reads the address in question and uses it to transmit the speech data. According to a second example the IP address may be sent in a predetermined packet, such as the first packet, to the Internet server 204. The Internet server 204 reads the address sent and uses it for the transmission of speech data. According to a third example, an arrangement is realized in a suitable network element e.g. as a database solution according to which a second identifier, such as a second IP address, is attached to the subscriber identification proper of the mobile station 101, to which address the speech data or the like is transmitted. An advantageous location for the identifiers is e.g. the visitor location register (VLR) of the mobile switching center 104. It is obvious to a person skilled in the art that the identifiers may be placed in other such network elements, such as the gateway 201, in which the data can be stored. When a connection is being set up, the device in question finds in the visitor location register in addition to the first subscriber identification data the second subscriber identification data including at least the address to which speech data is to be transmitted. By means of the address it is possible to establish a circuit-switched connection at least between the mobile station 101 and gateway 201 for the transmission of speech data.

In a second advantageous embodiment according to the invention, as depicted in Fig. 3, there is a connection from a base station controller 103 to a mobile switching center 104 in connection of which there is a gateway 201 such as the one described above. In this embodiment the gateway 201 is connected to a node 301 in the packet-switched GPRS backbone network 113. Further, the GPRS backbone network 113 is connected through a gateway GPRS support node 110 to a network using the IP protocol, such as the Internet network 203. A solution according to this arrangement requires that the gateway GPRS support node 110 is adapted so as to

separate the speech data packets coming from the gateway 201 and going to the gateway 201 from the other data packets going to the serving GPRS support node 108. It is obvious to one skilled in the art that node 301 in the GPRS backbone network is arranged so as to be as close as possible to the IP network 203 to which a connection has been established, so that a possible deterioration of the quality of the data transmitted through the circuit-switched connection can be eliminated.

In a third embodiment according to the invention the gateway 201 can be directly connected to a serving GPRS support node 108, as depicted in Fig. 4. The mobile station 101 uses a circuit-switched connection for the transmission of speech data up to the gateway 201 which converts the circuit-switched data into packet format and sends the speech data packets to the serving GPRS support node 108. The serving GPRS support node 108 is arranged so as to see from the speech packets coming from the gateway 201 that the transmission of data is now being carried out in both directions through the gateway 201 and mobile switching center 104. Advantageously this is arranged in a similar manner as e.g. a handover between two base stations 102. It is obvious to a person skilled in the art that this third embodiment according to the invention requires that the gateway 201 supports an interface enabling the arrangement described above. One such interface is the Gb interface of the UMTS (Universal Mobile Telecommunication System) network. It is obvious to one skilled in the art that the requirements according to the third embodiment of the invention can be met by realizing the necessary modifications in the serving GPRS support node 108.

The connections described above are optimized in such a manner that the capacity is utilized as efficiently as possible from the network standpoint. One possible way of optimizing the use of capacity is to leave out, where possible, the connection information needed in the data transmission and to transmit only the data proper. An arrangement like this can be realized for data traffic between a mobile station 101 and gateway 201 where, according to an embodiment of the invention, the whole IP protocol may be left out.

It is obvious to a person skilled in the art that in the fourth and fifth embodiments described above the mobile station 101 may be a class A, class B or class C device because the arrangements described above do not require a simultaneous circuit-switched and packet-switched connections at the mobile station 101.

The gateway 201 described above is depicted as a separate network element but it is obvious to one skilled in the art that the gateway 201 may be integrated into a suitable network element, such as a mobile switching center 104.

One possible arrangement for guaranteeing the connection quality is one in which the network elements providing packet-switched data transmission service monitor the quality of the connection. What is meant by this is that the network elements may e.g. monitor the data packet delays and other such quantities related to data transmission. Advantageously the monitoring is arranged in such a manner that if a network element notices e.g. that data packet delays become too long, i.e. the capacity of the packet-switched service is not sufficient to transmit all data with good enough quality, at least part of the data transmitted is arranged so as to be transmitted through a circuit-switched connection in accordance with the above description. It is obvious to a person skilled in the art that in the first, second and third embodiments described above the notion is to make sure in advance that the quality of the connection is good enough for the transmission of the data in question.

The embodiments described above have mainly related to the transmission of speech data through a circuit-switched connection but it is obvious to one skilled in the art that the invention is in every respect applicable to a situation in which the speech data is transmitted through a GSM speech channel. The invention can be applied, within the scope of the inventional idea defined by the claims, to the transmission of data such as speech data through a circuit-switched connection so that the quality of the data in question can be guaranteed to be sufficient from the receiver's standpoint.

It is obvious to a person skilled in the art that the connection described above, which is at least in part a circuit-switched connection between the terminal and gateway 201, can be understood in a broader sense. In addition to the connection types mentioned here the connection may be e.g. a circuit-switched data connection through which IP packets containing speech information can be transmitted. On the other hand, the connection may be e.g. a circuit-switched speech connection. One such connection is typically a so-called bearer in the GSM system, for example. In the case of a circuit-switched data connection the speech in the IP packets remains unchanged from the beginning to the end of the connection, whereby the gateway 201 will not convert the speech data from the circuit-switched connection into a form suitable for a packet-switched connection. It is unnecessary since the speech data in the IP packets is suitable as such to be transmitted through the packet-switched connection. In the case of a circuit-switched speech connection the gate-

way 201 converts the speech information into packet form so that it is suitable to be transmitted through a packet-switched connection.

It is obvious to a person skilled in the art that while it was above discussed the application of the GPRS network almost solely in connection with an Internet network, it may also be applied to other corresponding network topologies realizing packet switching. The names of the network elements mentioned above are not in any way limiting, but it has been our intention to follow, where applicable, the naming conventions used in the present GSM network.

Claims

1. A method for guaranteeing the quality of a connection in a data-transmitting telecommunication system, where the data is arranged so as to be transmitted through a packet-switched connection, **characterized** in that at least part of the data transmitted through the packet-switched connection is arranged so as to be transmitted at least partly through a circuit-switched connection.

2. A method according to claim 1, **characterized** in that at least one of the parties to the connection is a mobile station (101).

3. A method according to claim 1, **characterized** in that the data is transmitted through at least one Internet server (204).

4. A method according to claims 2 and 3, **characterized** in that from the mobile station (101) an IP address is sent to an Internet server (204) for establishing a circuit-switched connection.

5. A method according to claim 4, **characterized** in that the mobile station (101) sends an IP address to an Internet server (204) in the form of a short message.

6. A method according to claim 4, **characterized** in that the mobile station (101) sends an IP address to an Internet server (204) in a certain packet in the packet data stream.

7. A method according to claim 2, **characterized** in that a subscriber-specific IP address stored in the mobile communication network is used for the establishment of a circuit-switched connection.

8. A method according to claim 1, **characterized** in that at least part of the data transmitted through a circuit-switched connection is speech data.

9. A method according to claim 8, **characterized** in that said speech data is transmitted at least partly through a circuit-switched connection between the GPRS backbone network (113) and the mobile station (101).

10. A method according to claim 8, **characterized** in that said speech data transmitted at least partly through a circuit-switched connection is transmitted from the gateway (201) directly to an Internet server (204).

11. A method according to claim 1, **characterized** in that at least part of the data transmitted through a packet-switched connection is arranged so as to be transmitted through a circuit-switched connection if the capacity of the packet-switched connection is insufficient.

12. A method according to claim 10, **characterized** in that the quality of the packet-switched connection is monitored during the connection.

13. A network element for guaranteeing the quality of a connection in a data-transmitting telecommunication system, where the data is arranged so as to be transmitted through a packet-switched connection, **characterized** in that the network element is arranged so as to transmit at least part of the data transmitted through a packet-switched connection at least partly through a circuit-switched connection.

14. A network element according to claim 13, **characterized** in that the network element is arranged so as to convert the packet data into a form suitable for a circuit-switched connection and vice versa.

15. A network element according to claim 13, **characterized** in that it is a gateway (201).

16. A network element according to claim 13, **characterized** in that it is a mobile switching center (104).

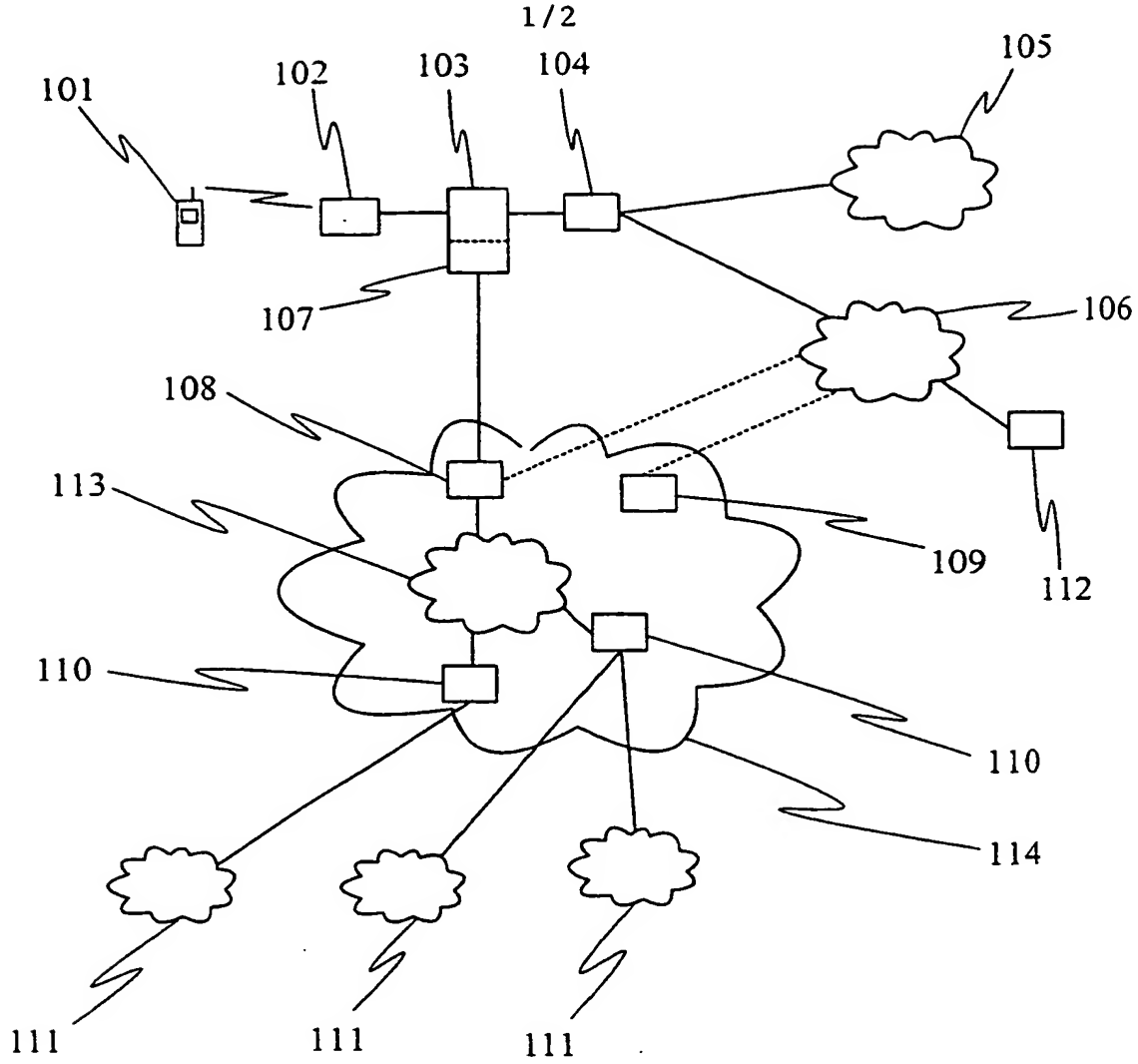

Fig. 1

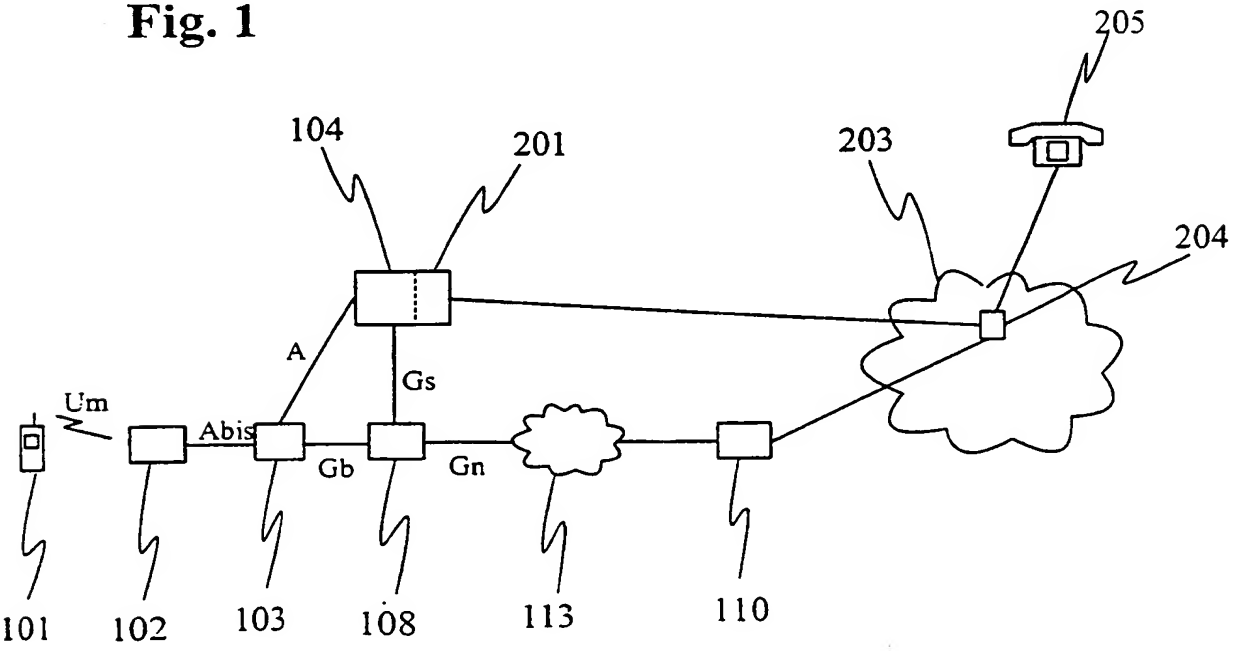

Fig. 2

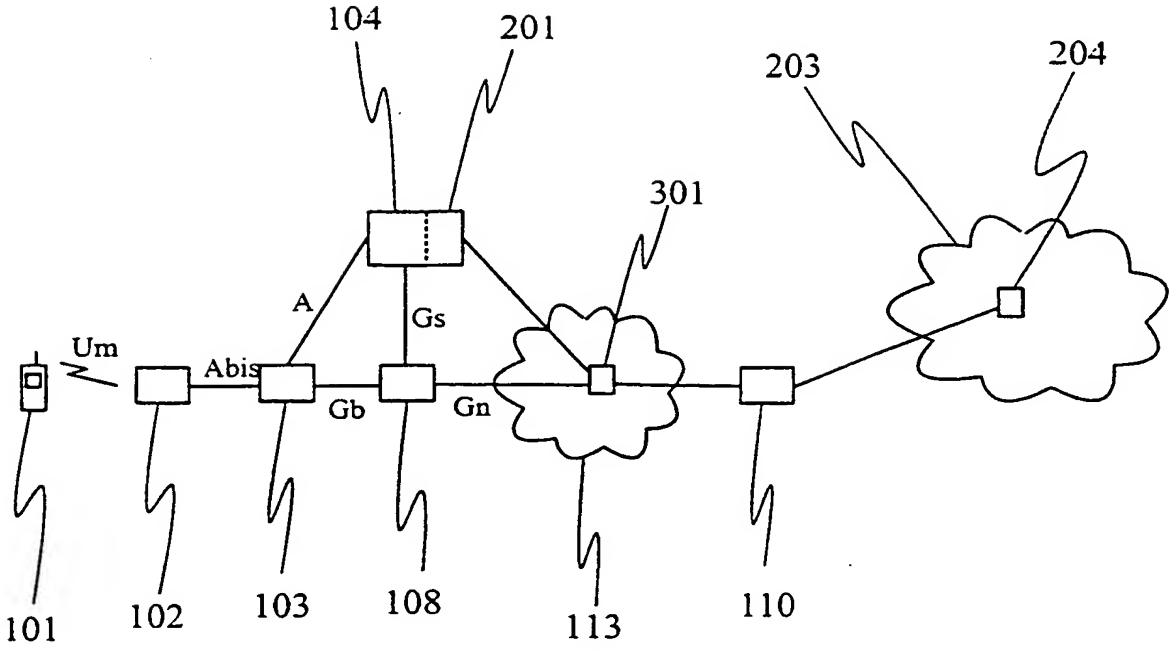

Fig. 3

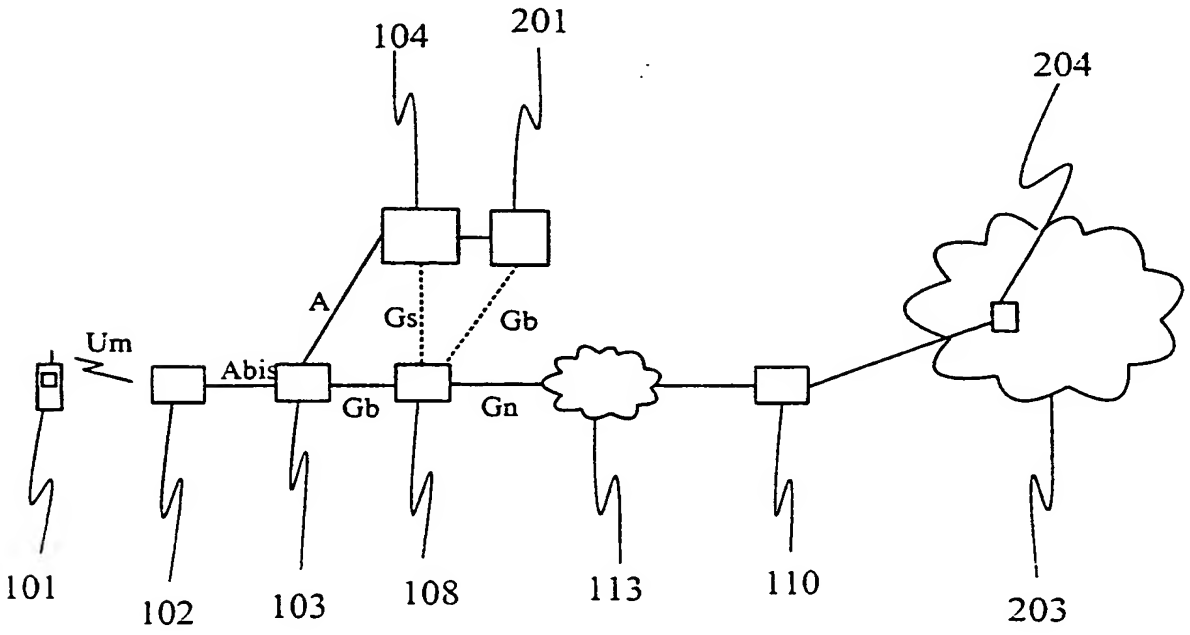

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/22
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9916266 A1 (TELEFONAKTIEBOLAGETLM ERICSSON (PUBL)), 1 April 1999 (01.04.99), page 8, line 17 - page 10, line 6; page 11, line 18 - line 24; page 16, line 24 - page 19, line 9	1-16
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00422

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9525407 A1 (SIERRA WIRELESS, INC.), 21 Sept 1995 (21.09.95), page 2, line 15 - page 3, line 9, abstract -- --------	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
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